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Rational Financial Meltdowns

Manuel A. Utset*

I. INTRODUCTION

Markets are complex institutions created and maintained by myriad actors, working in the shadow of legal rules and private agreements. Why create markets? For one thing, they help aggregate information about the preferences of market participants and their expectations or beliefs about the asset’s current and future value, and to present the end result in intuitive, simple to understand manner: a market price.1 Brokers and dealers help keep markets in good working order by acting as intermediaries between buyers and sellers, extending them credit, and, in the case of market-makers, stepping in to make sure that they always have someone to trade with.2 Intermediaries also assist in transferring funds and delivering the purchased assets.3 The assets traded in financial markets include vanilla securities (such equity and debt issued by firms), commodities, and derivatives—securities that derive their value from that of other assets, such as mortgages, credit card receivables, and even other derivative securities.

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1. See Friedrich A. Hayek, The Use of Knowledge in Society, in INDIVIDUALISM AND ECONOMIC ORDER 77, 86 (1948) (arguing that the price system allows individuals to make the right decisions by merely acting on the price, through which “only the most essential information is passed on and passed on only to those concerned”).
2. See MARKUS K. BRUNNERMEIER, ASSET PRICING UNDER ASYMMETRIC INFORMATION: Bubbles, Crashes, Technical Analysis, and Herding, 166 (2001) (describing stock market crashes as significant drops in the value of traded securities that occur notwithstanding fact that there are no significant news showing that there is an overall change in the fundamental value of those securities).
Financial markets are, as a general matter, reliable, robust institutions: they can absorb unexpected shocks and continue working with little or no downtime. Sometimes, however, they simply break down, and stop working altogether or hobble along at a reduced capacity for relatively long periods of time or they require the quick and costly intervention of governments to bring them back into some sort of working order. I will refer to this sort of institutional failure, as a market "meltdown." In 2007 and 2008, the United States and the rest of the world experiences a series of meltdowns in the markets for real estate, real estate mortgages, real-estate-mortgage-backed securities, other types of asset-backed securities, credit default swaps, repos, money markets, commercial paper, commercial loans, and a number of other markets. Some of these meltdowns were dealt with in short-order, but the markets themselves failed to recover fully for much longer periods.

What is striking, however, is not just that so many markets broke down over a relatively short period of time—after all, many of these discrete markets were interconnected with each other through meta-markets that traded composite securities made up of assets drawn from different markets. What is striking is the mere existence of so many markets and meta-markets. The proliferation of markets was part of well-intentioned and in some instances opportunistic attempts to help parties deal with risk, in a well-ordered fashion: by identifying a set of uncertain future states of the world, encapsulating each state into a security, and creating a market to trade them. In an ideal world financial engineers would create a security to handle each possible future state of the world, and market designers would create market for all of these securities, and this complete market would allow parties to manage the future in an orderly fashion. In a less than


5. See Maureen O'Hara, Market Microstructure Theory 14-16 (1995) (describing ways in which financial institutions help create markets, including helping facilitate transactions and assuring that there is sufficient liquidity for those wishing to trade).

6. The most common way to model uncertainty is to posit that at any one point in time, the environment is in a particular state, reflecting a set of properties true to the environment at that time. See Kenneth J. Arrow, The Limits of Organization 33-34 (1974) (stating that a decision-maker will "consider the world to be in one or another of a range of states," where a state of the world is "a description which is complete for all relevant purposes").

7. A "state-contingent security" helps parties make decisions that take into account both uncertainty and time. In a complete market, in which there exists one state-contingent security for each possible future state of the world, parties are able to hedge for all possible risks. See Kenneth
ideal world, one is left with a large number of markets, complex securities, complex financial institutions creating and these markets and designing and marketing these securities, and these same institutions, as well as institutional investors and business firms believing that they have hedged (and/or gambled) wisely, in the shadow of “almost-complete markets.”

There is much about the story that is sensible and rational. Hubris and self-dealing obviously played a part, as did systematic mispredictions of risks, preferences, and the efficiency of markets. This article focuses on the following question: how can a group of rational, and often very sophisticated, financial actors cause financial meltdowns, in the regular course of business? There is no doubt much we still need to learn about irrational financial meltdowns, but more likely than not, cognitive shortcomings only make matters worse: they exacerbate the type of behavior that can lead even super-rational actors to cause financial meltdowns.

Part II describes a set of problems created by certain dysfunctional group dynamics and informational asymmetries, the role played by financial intermediaries in helping reduce these problems, and a number of risks associated with relying on intermediaries.

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9. See Robert C. Merton, Financial Intermediation in the Continuous Time Model, in CONTINUOUS TIME FINANCE 370 (1992) (setting forth a sustained defense of financial engineering, notwithstanding the fact that the “products” that they produce mimic “high-speed passenger trains”: socially beneficial but open to a few derailings before all of the kinks are worked out).

10. I will adopt the standard economic assumption that a rational actor will be guided by an underlying preference to maximize its utility, which, without loss of generality, we can assume involves maximizing its net monetary returns. One can easily incorporate other factors that may affect the decision-making process of corporate actors. See, e.g., Manuel Utset Reciprocal Fairness, Strategic Behavior & Venture Survival: A Theory of Venture Capital-Finance Firms, 2002 WISC. L. REV. 45 (2002) (developing reciprocal fairness model within context of start-up firms, in which actors are concerned both with monetary returns and fairness).
II. INFORMATION, MARKET FAILURES, AND FINANCIAL INTERMEDIARIES

This Part begins by describing group pathologies that can reduce the joint welfare of group members, as well as the extent to which informational asymmetries between transacting parties can affect the proper working of markets. It then describes the role played by financial intermediaries and financial markets in helping reduce the social costs associated with group pathologies and informational asymmetries. The next section, however, identifies a potential problem of relying on financial intermediaries: parties transacting with intermediaries face the same type of informational problems—they do not know certain material things about the type of intermediary that they are dealing with and about the actions taken by the intermediary on their behalf. The last section examines the symmetrical nature of the informational asymmetry problems faced by intermediaries and the parties with whom they transact.

A. INFORMATIONAL ASYMMETRIES AND MARKET FAILURES

Neoclassical economics focused on the behavior of actors interacting in perfectly competitive markets. Acts in these models are perfectly rational automatons, who react to price signals and choose the course of action which maximizes their utility. Beginning with Coase’s, The Nature of the Firm, and continuing with the rise of modern microeconomic analysis, the emphasis turned to microbehavior: the actions of actors within firms and individuals within households received greater attention. In particular, economists

12. Neoclassical economics, in short was concerned with studying markets, and to do so, it was helpful to assume that the actors, including households and firms, had fully specified and stable profit making and utility functions and always acted in the manner best suited for maximizing profits and utility, respectively. See David M. Kreps, A Course in Microeconomic Theory 5 (1990) (describing traditional economic models of consumer choice in impersonal markets in which price is given and consumer choose action to maximize utility given its budget constraints); James M. Henderson & Richard E. Quandt, Microeconomic Theory: A Mathematical Approach 64 (3rd ed. 1980) (describing neoclassical firm as a “black box” through which inputs are transformed into outputs, subject to technological constraints).
14. Id. at 388, n. 2 (describing production through a firm as coordinated by an entrepreneur (or manager) who directs production by fiat: an “entrepreneur” in a competitive market system is a person who “take[s] the place of the price mechanism in the direction of resources”).
gave greater attention to potential conflicts among these individuals and how these could undermine the broader goals of maximizing a firm’s profits or a household’s aggregate utility.15

One refinement of the neoclassical model draws a distinction between the aggregate welfare of a group of individuals—firms, households, as well as other types of groups—and the individual welfare of its members.16 A group may fail to maximize its total welfare under a variety of contexts. Collective action problems,17 such as the tragedy of the commons18 and free rider problems,19 and various similar dynamics, such as the prisoner’s dilemma,20 can lead group member to choose self-serving courses of action that will make them worse off than if they had all precommitted to do what was best for the group.21 In some cases, group members have the same individual goals but fail to coordinate their behavior because they each commit to a course of action before they know what others have done.22 As a result, they may end up acting in a manner that fails to maximize the group’s aggregate welfare. Both collective action and coordination problems are due to informational problems: At the time that each actor acts, they are unaware of how others have acted (they move simultaneously).23


17. See MANCUR OLSON JR., THE LOGIC OF COLLECTIVE ACTION (1965) (setting forth general theory of collective action problems in which the size of the group and the costs of communication play an important role).


22. See infra Part IV.E. (setting forth the general problem of coordination failures in the context of runs on repos).

23. See DREW FUNDENBERG & JEAN TiROLE, GAME THEORY, 9–10, 18–20 (1991) (describing prisoner’s dilemma and coordination games as simultaneous move games, in which
A second refinement to the neoclassical model focused more directly on informational asymmetry problems between actors, and the effect of these asymmetries on behavior of self-interested actors.24 One type of informational asymmetry problem involves a party's incomplete information regarding certain material characteristics of another party or a product that they are selling.25 For example, a shareholder who hires a manager to run its firm will have incomplete information about the manager: Is she hardworking and honest? Does she have the requisite general skills to manage a company and the specific skills needed to run this company in particular?

Another way of stating the general problem is that a shareholder is choosing from a pool of managers, where the pool members differ along a number of parameters: they have different "types."26 A shareholder that is unsure about the type of the manager that it is hiring may do a number of things to protect itself: discount for the risk that the manager is of an inferior type (by offering it a lower salary that the one it would pay a manager of the superior type),27 it may acquire information to distinguish between the various types of managers (including hiring a third party to certify),28 or it may protect itself contractually, such as by giving the manager a short-term employment contract or requiring it to post a bond (take part of its compensation on a contingent basis based on whether the manager turns out to be of the superior type).29 At the same time, managers of a superior type will try to find a way to credibly communicate this fact to the shareholder. In this context, a credible statement is one that is self-verifying: it is one that superior type managers are able to make

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25. See George Akerlof, The Market for Lemons: Qualitative Uncertainty and the Market Mechanism, 84 Q. J. Econ. 488 (1970) (setting forth standard treatment of adverse selection problem in context of used car dealers, which have informational advantage over potential purchases of "lemons").

26. See Jean Tirole, The Theory of Corporate Finance 241–42 (2006) (describing asymmetric information model in which one party is unsure about the characteristics or "type" of the other party).

27. See id. at 242–43 (describing discounting for risk and its effects, such as leading good types to cross-subsidize bad types, and in certain instance to the failure of parties to reach an otherwise beneficial agreement).

28. See id. at 246 (describing use of certification by underwriters to deal with adverse selection problems faced by a company issuing new securities).

29. See Oliver E. Williamson, Corporate Finance and Corporate Governance, 43 J. Fin. 567 (1988) (describing use of contractual safeguards and bonds to deal with informational asymmetry problems).
but inferior one find it too costly to mimic.\textsuperscript{30}

In the second type of informational asymmetry problem, a party cannot fully observe the actions of a second party.\textsuperscript{31} Suppose that the shareholder has hired a manager to run the firm. The manager will undertake a series of managerial actions that will affect the shareholder's welfare. The manager will set certain business goals, acquire information about the various ways of achieving those goals, choose the best course of action, and executed at the time best suited for maximizing the firm's profit. The shareholder is unable to observe many of the manager’s deliberation process and the set of actions that it undertakes to achieve chosen business goals. This includes the shareholder's general inability to observe how much effort the manager exerts in identifying business goals, the best way of achieving them, and carrying out the chosen course of action.\textsuperscript{32} In order to protect itself, against this agency (or moral hazard) problem, it can tie part of the manager’s compensation to one or more metrics that is observable by the parties, after the fact—such as earnings and other accounting measures and changes in the value of the company.\textsuperscript{33} For example, the shareholder may give the manager a compensation package that includes bonuses, restricted stock, and/or stock options.\textsuperscript{34} A shareholder may also protect itself by reducing the manager’s overall pay to hedge against potential losses from agency problems. A manager may thus expend resources to alleviate the informational risks faced by the shareholder, such as hiring independent third parties to certify that the manager is acting in an appropriate manner.\textsuperscript{35} Independent public accountants, underwriters, and rating


\textsuperscript{32} See MILGROM & ROBERTS, \textit{supra} note 24, at 179–85 (setting forth various contexts in which moral hazard problems arise within organizations and in financial markets).

\textsuperscript{33} See \textit{id.} at 185–89 (describing various ways to deal with moral hazard problem, including monitoring, bonding, and incentive mechanisms).

\textsuperscript{34} See Rajesh K. Aggarwal, \textit{Executive Compensation and Incentives}, in 2 \textit{HANDBOOK OF CORPORATE FINANCE} 498, 500–05 (B. Espen Eckbo ed. 2007) (discussing use of restricted stock and stock options to compensate managers, as well as various other components of standard compensation packages).

\textsuperscript{35} See Jensen & Meckling, \textit{supra} note 15, at 308 (agents will sometimes incur bonding cost in order to reduce agency costs).
agencies often act as third-party certifiers; independent board members can also act as certifiers, although given their ongoing relationship with managers, their independence is more easily compromised.

In conclusion, the neoclassical model’s assumption that markets are perfectly competitive, that market participants choose how to act based on price signals and on their underlying objective to maximize their utility is a useful one if one is modeling perfectly competitive markets and is trying to understand the behavior of firms and consumers. However, markets may fail to act in a fully competitive manner due to informational problems: market failure may occur due to the cost or impossibility to transfer and verify information within groups or inability to accurately aggregate the preferences of individual group members to come up with a way of determining whether group members are maximizing their aggregate welfare. A second type of market failure is due to a combination of informational asymmetries and strategic behavior. In order to address market failures it is necessary to deal with the informational problems within groups and between transacting parties. One can do so, by reducing the costs of acquiring the information or providing actors with a way to hedge for the potential bad results flowing from their informational deficits. Financial intermediaries and financial markets help with both.

B. FINANCIAL INTERMEDIARIES AND FINANCIAL MARKETS

Financial intermediaries, such as banks, investment banks, hedge funds, equity and venture capital funds, are matchmakers: They identify and bring together potential investors and firms in need of funds, and help reduce information-based transaction costs. Without intermediaries some transactions may never get done, and others will be more expensive to consummate. In return for their services, intermediaries will take a cut of the surplus produced by their services. Intermediaries help deal with adverse selection problems: they screen investments and certify the quality of firms.

36. See Martin F. Hellwig, Financial Intermediation and Risk Aversion, 67 REV. ECON. STUDIES 719, 719-720 (2000) (modeling intermediation as a relation between intermediaries, the investors providing the funds and the firms making use of these intermediated funds, and complaining that many studies fail to approach the two sets of financial contracts in a holistic fashion).
They also play a role in reducing moral hazard risks, as well as assisting dispersed investors, such as depositors and shareholders, deal with collective action problems and potential coordination failures.

Financial markets help reduce information asymmetry problems by aggregating the information and knowledge of dispersed actors into a single statistic: the market prices. Well-established firms issuing well-understood securities such as common stock and standard debt securities, can often bypass intermediaries and raise funds directly from investors. All other things being equal, parties will tend to choose intermediaries over markets when the firms seeking funds do not have a proven track record or are engaged in businesses that are complex or difficult for nonexpert third parties to value—e.g., innovation intensive firms.


38. See Sudipto Bhattacharya et al., Monitoring by and of Banks: A Discussion, in CREDIT, INTERMEDIATION, AND THE MACROECONOMY 122, 122 (Sudipto Bhattacharya et al. eds. 2004) (stating that informational intermediaries are able to avoid free ricer and reduce coordination problems that beset decentralized investors in capital markets).

39. See Robert C. Merton, A Functional Perspective of Financial Intermediation, 24 FIN. MANAG. 23, 26 (1995) (arguing that financial markets are efficient alternatives to financial intermediaries, only to extent that securities are standardized, widely distributed and are “well-enough ‘understood’ for transactors to be comfortable in assessing their prices”).

40. For example, start-up companies go through various phases that further illustrate the relative role played by intermediaries and markets. During the early phases of the business, entrepreneurs often borrow directly from family members or friends. However, they also resort to financial intermediaries by using credit cards or borrowing from banks and giving a personal guarantee. As the start-up becomes more established they may get financing from venture capitalists. Venture capitalists sell partnership interests to institutional investors and wealthy individuals in start-up companies. As such, they are an example of a financial intermediary. As a result they act as financial intermediaries between the investors and the companies in which they make equity investments. As with banks, they provide value to their investors thorough their expertise in screening, valuing, and monitoring investments. Even after venture capitalists become involved, entrepreneurs will sometimes acquire funds directly from wealthy individuals—i.e., angel investors. Finally, at the time of an initial public offering, underwriters act as informational intermediaries between the company insiders and potential purchasers of the stock. At the time of making an investment in a start-up company, a venture capitalist will have incomplete information about (1) the innovation, and (2) whether she is a hard worker with the required skills to run the venture. See Raphael Amit, Lawrence Glosten, & Eitan Muller, Entrepreneurial Ability, Venture Investments, and Risk Sharing, 36 MANAGEMENT SCIENCE 1232 (1990) (setting forth an adverse selection model in the context of venture capital financing); PAUL A. GOMPER & JOSH LERNER, THE VENTURE CAPITAL CYCLE 3 (1999) (discussing informational risks associated with venture capital investments).
C. The Second-Order Risks Created by Financial Intermediaries

Financial institutions acting as intermediaries are subject to same sort of group dynamics, adverse selection, and moral hazard problems faced by non-financial, business firms. However, financial institutions are more likely to experience sudden failures due to insolvency and liquidity problems. An insolvent firm has liabilities that exceed its assets, and will fail or be forced into reorganization proceedings if its creditors require immediate payment of the amount owed. A firm facing a liquidity problem has sufficient assets to pay its liabilities but is unable to raise capital from third parties or transform its assets into cash quickly enough to meet its obligations.

A liquidity problem can lead to insolvency, as the firm begins to default on its loans. Defaults will in turn exacerbate the liquidity problem since potential lenders may refuse to extend credit, or if they do so, they will require a greater amount of collateral and charge higher interest rates. This sort of liquidity-insolvency spiral can cause a financial institution to fail, not due to unexpected declines in the value of its assets, but from having its cash reserves and access to working capital disappear. Financial institutions are particularly susceptible to this sort of spiral, given that they finance their operations using relatively short-term debt and make extensive use of

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41. A firm facing an insolvency or liquidity problem may try to renegotiate its debt. These sort of renegotiations are more likely to succeed the fewer the number of creditors involved and to the extent that they have common interests—e.g., same type of priority. See Alan Schwartz, Contracting About Bankruptcy, 13 J.L. ECON & FIN. 127, 136–38 (1997) (discussing renegotiation issues between debtor firms and their creditors).

42. See Bankruptcy Code, 11 U.S.C. § 101(32) (2010) (defining insolvency of an entity as the “financial condition such that the sum of such entity’s debts is greater than such entity’s property, at fair valuation”).

43. While an insolvent firm can, in theory, can continue to operate until it experiences a liquidity problem: until it runs out of cash or other liquid assets to pay its creditors, creditors can force the insolvent firm into bankruptcy. See Bankruptcy Code 11 U.S.C. §303 (2010) (involuntary filing).

44. A firm that is forced to sell its assets quickly will often have to sell them at a discount, which not only exacerbates the liquidity problem but can lead to insolvency. See Jean Tirole, Illiquidity and All Its Friends, 49 J. ECON LIT. 287, 289 (2011) (discussing problem of market liquidity).


46. Highly leveraged firms are more likely to suffer liquidity problems; moreover, high leverage may signal to the market that the firm is borrowing funds because it is unable to produce sufficient internal cash flows to fund its operations or is insolvent. See Zvi BODEI ET AL., INVESTMENTS 472 (2005).
leverage. In fact, financial institutions routinely tie up their funds in long-term commitments, such as long-term loans or insurance contracts, which they finance in part by using short-term debt.

Since short-term debt is less risky than long-term debt and other long-lasting financial contracts, institutions can make a profit by borrowing at a relatively low rate and using those funds to enter into long-term commitments, for which they can charge more. As long as institutions have continued access to short-term funds, the maturity mismatch between their operating capital and their contractual commitment is of no material consequence. However, if an institution begins to experience liquidity problems, the maturity mismatch can quickly turn into significant problem, that in some instances can lead to its sudden failure. Intermediaries, such as brokerage houses, can also suffer a liquidity shock if their customers close their accounts and take their cash and securities to another institution. It follows that part of the risk management task faced by financial intermediaries involves monitoring short-term lenders and customers, as well as other suppliers of capital and cash flows. A bank can experience liquidity shocks if it fails to identify, on a timely basis, changes in their depositor base, or increased regulatory anxiety about its financial state of that of similarly situated institutions, and concomitant changes in oversight and capital requirements. Part IV examines two contexts in which group dynamics by short-term lenders—depositors and repo lenders—can cause financial institutions to experience liquidity shocks, which at an extreme can lead them to fail.

47. See Robert C. Merton, Financial Intermediation in the Continuous-Time Model, in CONTINUOUS-TIME FINANCE 337, 354 (1990) (discussing the various ways in which financial institutions raise capital); JEAN TIROLE, supra note 26, at 98–99 (stating that banks have high leverage ratios).


D. THE TWO-SIDED INFORMATIONAL ASYMMETRY PROBLEMS PRESENT IN INTERMEDIATION TRANSACTIONS

Transactions involving intermediaries create a two-sided informational asymmetry problem: Parties who rely on intermediaries need to protect themselves against the informational risks posed by the intermediaries; in turn, the intermediaries must protect themselves from the informational risks posed by those parties. More generally, intermediation transactions involve at least three two-sided informational asymmetry problems. The first is between the intermediary and its investors, lenders, and customers. The second is between the intermediary and the borrowers and other investors with whom they enter into long-term transactions, who are exposed to counterparty risk, if the intermediary fails. The third two-sided informational asymmetry problem involves the parties who transact with the financial intermediary. Complete intermediation is, in the end impossible. There always remains a portion of the informational risk in the disintermediated plane: A depositor’s welfare is affected by the en masse loan defaults by the bank’s borrowers and the borrowers’ welfare is affected by the disruption in funding (and informational losses) created by bank runs or the bank’s orderly dissolution by the FDIC. Repo transactions, securitizations, credit default swaps and other types of derivative transactions involve analogous sorts of “transitive counterparty risks.”

III. INVESTING IN INFORMATION

This Part begins by setting forth a general framework for understanding financial decisions: They are inter-temporal decisions in which actors use their current beliefs to make predictions about how their environment and how they expect it to evolve over time. Over time, a financial actor will revisit its past decisions making use of new information to update its beliefs. It will then use those new beliefs to determine the extent to which they need to adjust their investment portfolio. But information is itself a type of investment: it requires the actor to incur an immediate cost in return for a signal of uncertain value. It follows, that like any other investment, an actor will choose

not just how much information to acquire but also the optimal time to do so. Waiting is sometimes the best course of action. The Part therefore continues with an examination of the optimal time to invest in information and the value of the option to delay the investment. Financial institutions and financial contracts are often quite complex, which means that the information needed to pierce through that complexity can be expensive and in some cases not worth acquiring. The Part concludes by examining various issues related to this complexity.

A. MAKING FINANCIAL DECISIONS

Suppose that a financial actor is has available a number of possible courses of action and wants to choose the one that will maximize its intertemporal utility: each of these actions will produce an immediate result, providing the actor with an instantaneous utility; it will also produce potential positive or negative hits to its utility in future periods.\(^5\) For example, a decision to buy a share of stock will require an immediate disutility—the amount paid to make the investment—and will yield an expected return in the future, which will depend on the state of the environment that comes to pass. The net return, and thus the effect on the actor’s future utility, will depend on how well the company performs during the life of that investment. The actor’s future utility will therefore depend on dividend payments received over time, and the capital gain/loss when it sells the stock. A rational actor will decide whether or not to purchase the stock at time \(t\), if doing so will maximize its aggregate, inter-temporal, utility in periods \(t\) through \(t + n\), where the latter is the date in which the actor sells the stock.

During the time that it owns the stock, the actor may have one or more available actions that will affect its inter-temporal utility. It may, for instance, acquire information about the company’s financial health, and use what it learns to make subsequent decisions, such as selling the stock earlier than planned, hedging, carrying out a proxy battle, bringing a lawsuit, or purchasing additional shares. An actor’s

\(^5\) A rational actor will take an action in the current period if it is inter-temporally worthwhile: if, given her belief of how she plans to act in the future, the action maximizes her current and future well-being. See Ted O’Donoghue & Matthew Rabin, *Choice and Procrastination*, 116 Q.J. ECON. 121, 128 (2001) (setting up a general model where people act with reasonable beliefs about future actions and choose current actions to maximize preferences in light of those beliefs).
inter-temporal utility therefore will depend on how it acts initially and in subsequent periods, and everything else beyond its control, which we will refer to as the actor’s environment.\textsuperscript{52}

An actor’s decision will depend on it beliefs\textsuperscript{53} regarding: (1) the current state of the decision environment;\textsuperscript{54} (2) the actions available to it, to reduce its level of uncertainty\textsuperscript{55} (including hedging against possible outcomes); and (3) how its actions will affect that environment.\textsuperscript{56} One way to reduce this uncertainty is to invest in information.\textsuperscript{57} The actor pays a certain amount at time t, to receive a

\textsuperscript{52} More generally, an environment can be characterized as a system—a set of components, each in some relation with others. Each of these components may be considered its own environment, to the extent that it is composed of other components, and so on until one bottoms out at a set of primitive components. This sort of compositional approach to “constructing” environments helps reduce their overall complexity. \textit{See} C. A. R. HOARE, \textit{COMMUNICATING SEQUENTIAL PROCESSES} 45 (2004) (stating that compositional design helps reduce complexity of reasoning about complex concurrent systems by treating equally all relationships between observer and environments, and arguing that a “complete system should also be regarded as a process, whose range of behaviour is definable in terms of the behaviour of its component processes; and the system may in turn be placed within a yet wider environment”).

\textsuperscript{53} The actor will attach subjective probability assessments based on its beliefs about the current state it holds at the time. More generally, a person will want to know whether or not certain propositions about his environment are true—i.e., that they are true in the current state of the environment. \textit{See} Eddie Dekel & Frank Gul, \textit{Rationality and Knowledge in Game Theory}, in \textit{ADVANCES IN ECONOMICS AND ECONOMETRICS: THEORY AND APPLICATIONS, SEVENTH WORLD CONGRESS} 87, 99-101 (David M Kreps & Kenneth F. Wallis, eds. 1997) (describing Kripke model of knowledge). A belief is a type of disposition to assent to certain propositions about it. If A believes that X is true, then they would assent to the following proposition: “X is true.” To say that X believes that Napoleon lost at Waterloo just means that X has the disposition to answer yes if asked: “Did Napoleon lose at Waterloo?” \textit{See} WILLARD VAN ORMAN QUINE & JOSEPH SILBERT ULLIAN, \textit{THE WEB OF BELIEF} 10 (2d ed. 1978) (stating that a person has belief X if he has a disposition to assent to questions regarding those beliefs); Radu J. Bogdan, \textit{The Manufacture of Belief}, in \textit{BELIEF: FORM, CONTENT AND FUNCTION} 149, 160-61 (Radu J. Bogdan ed. 1986) (stating that beliefs “track” certain facts or information about the real world).

\textsuperscript{54} A decision-maker who has no beliefs about his environment will find it impossible to choose between different courses of action. At the same time, a person who believes that his actions will have no effect whatsoever will have no reason to act. \textit{See} FRED DRETSKE, \textit{EXPLAINING BEHAVIOR: REASONS IN A WORLD OF CAUSES} 79 (1988) (arguing that a model of belief should, in the end, “reveal the way in which what we believe helps to determine what we do”); FRANK RAMSEY, \textit{THE FOUNDATION OF MATHEMATICS AND OTHER LOGICAL ESSAYS} 238 (1931) (“[a] belief [is] a map of the neighbouring space by which we steer”).

\textsuperscript{55} The process can lead it to conclude that it needs to update its beliefs about the environment. \textit{See} ROBERT NOZICK, \textit{THE NATURE OF RATIONALITY} 67-69 (1993) (discussing various reasons for privileging true beliefs, but stating that in some rare contexts having false beliefs can make someone better off).

\textsuperscript{56} \textit{See} NOZICK, supra note 55, at 99 (“beliefs about the world feed forward into actions, and the (perceived) results of these actions . . . feedback, positively or negatively, upon beliefs”).

\textsuperscript{57} \textit{See} ARROW, supra note 16, at 37-38 (an economic actor starts with certain expectations about set of signals that it can receive in the future and a probability distribution of receiving
signal, at time \( t +1 \). As with any investment, a rational actor will purchase that signal only if the immediate costs are less than the expected benefits. An actor that receives a very noisy signal\(^{58}\) may not learn anything valuable, and may end up knowing less about the environment's true state; a very precise signal, on the other hand may reveal, the actual state.

In addition, to the type of signal that it expects to receive, the actor will also need to take into account the costs of processing the information and using it in its deliberation process. Some signals are difficult to interpret (to attach a precise meaning to information received); others may require added work to incorporate into the actor's existing information set, or to use in making a decision—deliberation take time and effort, both of which produce disutility. Moreover, some pieces of information may trigger negative emotions such as anxiety and regret.

Finally, an actor will take into account that the information that it is acquiring is timely. A signal is timely, only if the actor can use it to make a decision: For example, if the signal is received after the decision deadline or takes the actor too long to process and put into use. Moreover, an actor can receive a signal too soon: An actor who is unable to act before a specific point in time, will thus need to account for the likelihood that the information will become partly or fully stale (in the sense that it no longer provides as accurate an assessment of the environment's true state).\(^{59}\) For example, the efficient capital markets hypothesis states that information about companies whose following among analysts and expert traders is deep will become stale very quickly, sometimes within seconds.\(^{60}\)

We can thus look at the actor's decisions as taken place in three

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the different signals; “information” is a signal that leads the actor to update that probability assessment); over those signals, based on their current beliefs; “information” is a signal that leads an actor to make changes to that probability distribution); JACK HIRSHLEIFER & JOHN G. RILEY, THE ANALYTICS AND UNCERTAINTY OF INFORMATION 170–78 (1992) (describing process by which people revise their beliefs to account for new information).

58. See JACOB MARSCAK & ROY RADNER, ECONOMIC THEORY OF TEAMS 47 (1972) ("as a general matter,] information will give only a partial description of the state of the world").

59. Cf. Steve Furr, What is Real Time and Why Do I Need it?, QNX, www.qnx.com/developers/articles/article_298_1.html (last visited Apr. 5, 2013) (drawing a distinction between hard and soft real-time systems; in the former case, information that is not acquired by specified deadline loses all its value, while in the soft system information depreciates in value).

60. An inter-temporal decision is one in which the consequences or payoffs accrue at different points in time. See George Loewenstein & Richard H. Thaler, Intertemporal Choice, 3 J. ECON. PERSP. 181, 181 (1989) (defining inter-temporal choices as “decisions in which the timing of costs and benefits are spread out over time”).
periods: At time t, it will decide whether or not to make an investment in information; if it does, a time t + 1, it will receive an information signal and either process it and use it to make a decision (or ignore it); if it decides to use it, the actor will carry out an action at time t + 2, using that information. A rational actor will make an investment at time t, it the immediate costs of purchasing the information signal is less than the net expected benefits from using it. The latter will depend, in turn on the benefits received at time t + 2 minus the aggregate costs a t + 1 (such as processing, deliberation, and emotional costs). It will also depend on the signal’s timeliness.

B. THE OPTIMAL TIME TO INVEST IN INFORMATION

A decision to invest in information, therefore, has the following important characteristics. First, it involves an inter-temporal decision. Second, an information signal has uncertain payoffs. Third, the investment is costly to reverse, in the sense that once the actor has paid for the signal at time t, it cannot undo its decision, if the signal has little useful information about the environment, or if it no longer needs the information—if it has changed its mind about whether to undertake the underlying action, such as buying or selling stock, or it has received the information in some other way. In some instances, an actor can salvage part of its investment by selling the information to a third party. Third, in many types of contexts involving financial actors, there is flexibility about the timing of investing in information. A rational actor, therefore will make two general decisions: whether or not it is worthwhile to acquire information; and the optimal timing for doing so.

In choosing the optimal time, the actor will take into account the following factors. First, the immediate costs of acquiring the information, and the extent to which it can reverse part of the investment, by selling the information to a third party. The actor is more likely to delay the greater the net, irreversible investment. The second factor is the costs from delaying—if the actor can make the underlying decisions immediately after acquiring and processing the information, and that decision will begin to produce returns immediately. The greater these foregone returns, the greater the actor's incentive to invest in information, without waiting. Third, delay, buys time, whose value depends on the likelihood that the actor will make a different decision after the delay than the one it would make beforehand.

Suppose that the actor will acquire the shares only if the
company's expected earnings are at least $1 million, and that purchasing a signal at time t would tell the actor that the expected earnings are either $10 million or a loss of $8 million, each with a fifty percent likelihood; also suppose that waiting for the company to issue the earnings report will allow the investor to know for sure which of the two actually occurred. Instead suppose that the signal, at time t, would tell the actor that the company would have an average profit of $1 million, but with a lower variance: the company has a profit of either $2 million or $0, each with fifty percent probability. The option value of delaying making the investment if greater under the first scenario, and thus, the actor is willing to pay more for the signal if it believes that it is facing such a high variance scenario. The value of the information depends in short on the actor's ability to avoid the downside loss; if the company's losses money, then it will forego the investment.

One would thus expect that financial actors will spend less in acquiring information during economic booms, since all other things being equal, the downside risks of making an investment without the information is not as great. At the same time, during a bust, the value of the information becomes much greater given the greater downside risks of making an investment "blindly." It follows, that financial actors will have an incentive to delay investing in information during economic booms and to over-invest in it during busts. The former can lead to the prolonging of asset bubbles; the latter can lead to more severe busts.

C. COMPLEXITY AND THE OPTION TO DELAY INVESTING IN INFORMATION

We have assumed that rational financial actors choose the course of action that will maximize their inter-temporal utility and that they make decisions within a transactional environment, at a particular point in time.61 An environment's complexity depends on the number of parts it comprises and the manner in which these interact. Suppose that two environments have the same number of parts, but that in the first it is relatively more difficult for an observer to make sense of the dependency between the myriad parts; then that first environment is

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61. See Jon Barwise, The Situation in Logic, at xiv (1989) (developing "situation logic" in which actors find themselves within a context or situation—i.e., "portions of reality"—at a specific point in time).
a more complex one. A fully rational actor who has determined that the benefits of using a piece of information exceed the costs will take the time and effort to process and use that information. But deciphering a complex environment takes time and effort, and a certain level of computational ability. As information increases in complexity, the greater the chance that an actor will run out of time before it is able to process it and incorporate it into the deliberation process.

Complexity will increase the immediate costs of investing in information, and as a result will increase the value of actor's option to delay. This is important because the sort of inter-temporal decisions made by financial actors can quickly increase in complexity, given that a decision-maker has to make sense of its current and expected future preferences and the way that the environment may change over time. The level of complexity of inter-temporal decisions will tend to increase with the number of time periods involved, their length, and the interconnection between them.

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62. Herbert Simon defined a complex system as “one made up of a large number of parts that have many interactions,” where its complexity will increase because, “whenever the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole.” HERBERT A. SIMON, THE SCIENCES OF THE ARTIFICIAL 183–84, 207 (3rd ed. 1996).

63. In short, boundedly rational actors will engage in “satisficing” behavior by not using some of the information available to them. Id. at 29 (describing the boundedly rational decision-maker as “a satisficer, a person who accepts ‘good enough’ alternatives, not because less is preferred to more but because there is no choice”); HERBERT A. SIMON, MODELS OF THOUGHT 3 (1979) (starting with the “observation that human thinking powers are very modest when compared with the complexities of the environments in which human beings live” and describing the way they adapt to these computational constraints by using only a subset of the available and relevant information set). One approach to reducing the cognitive load needed to make decisions within complex environments is to use “rules of thumb” or heuristics that are well suited for the task at hand. See Amos Tversky & Daniel Kahneman, Judgment Under Uncertainty: Heuristics and Biases, in JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES 3 (Daniel Kahneman, Paul Slovic & Amos Tversky eds. 1982) (arguing that heuristics have benefits and costs, and can lead to systematic—i.e., non-random—deviations from rational behavior). All other things being equal, the use of heuristics will increase with the complexity of the environment. See, e.g., John W. Payne, Task Complexity and Contingent Processing in Decision Making: An Information Search and Protocol Analysis, 16 ORG. BEHAV. & HUM. PERFORMANCE 366, 384 (1976) (showing that “increases in the complexity of a decision situation will result in decision makers resorting to choice heuristics in an effort to reduce cognitive strain”).

D. COMPLEXITY OF FINANCIAL INSTITUTIONS AND FINANCIAL CONTRACTS

Even small financial institutions can be highly complex entities.\(^{65}\) The majority of the assets of financial institutions are financial in nature;\(^{66}\) these assets are more volatile and difficult to understand and value, since their value, at any one point in time depends on a large number of future states of the world.\(^{67}\) It follows, that, as a general matter, financial assets have greater complexity than the tangible assets held by nonfinancial firms. A financial institution's liabilities also tend to be complex given that large portions of them are held by its customers,\(^{68}\) and that some of them are not reported on their balance sheets.\(^{69}\) Moreover, the value of an institution's assets and the burden of its liabilities can fluctuate very rapidly, depending on the behavior of markets and regulators, as well as the institution's organizational structure.\(^{70}\)

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66. For example, the assets of commercial banks consist primarily of mortgages and consumer and commercial loans. See James Tobin, Financial Intermediaries, in 2 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 340, 342 (John Eatwell et al. eds. 1987) (describing the balance sheets of financial intermediaries as almost completely "paper" on both sides—securities and other financial claims as opposed to real assets—and the assets of commercial banks as comprising primarily mortgages, commercial loans, and consumer credit). The assets of insurance companies are primarily in the form of securities and other financial contracts (arguing that contractual complexity increases with "(1) the expected number of payoff-relevant contingencies specified in the contract; [and] (2) the variance in the magnitude of the payoffs contracted to flow between the parties," since these create more states of the world for a decision-maker to take into account).

67. See Karen Eggleston et al., The Design and Interpretation of Contracts: Why Complexity Matters, 95 NW. U. L. REV. 91, 97–100 (2000) (arguing that contractual complexity increases with "(1) the expected number of payoff-relevant contingencies specified in the contract; [and] (2) the variance in the magnitude of the payoffs contracted to flow between the parties," since these create more states of the world for a decision-maker to take into account).

68. See ROBERT C. MERTON, CONTINUOUS-TIME FINANCE 451 (Blackwell Publishers Inc. 2nd rev. ed. 1992) (1990) ("[T]he vast bulk of a typical intermediary's liabilities are held by its customers."). The level of complexity is increased by the fact that financial institutions sometimes trade for their own accounts, something that can create conflicts of interests with their customers. See, e.g., Dodd-Frank Wall Street Reform and Consumer Protection Act § 619, 12 U.S.C. § 1851 (Supp. V 2011) (restricting the ability of financial institutions to engage in certain types of proprietary trading).


Additionally, financial institutions are interconnected through contractual arrangements, such as loan or debt contracts and financial derivatives, and spot transactions, such as trading; they are also interconnected indirectly, through their reliance on the same sources of capital and markets to dispose of assets.\(^71\) The failure of one financial institution can put other institutions at risk,\(^72\) and even relatively small shocks to one part of the financial system can quickly spread to others, precipitating a financial crisis: A large, material change in the overall or aggregate state of a financial system arising from a relatively small change in the system.\(^73\) For example, banks routinely lend and borrow from each other, both locally and internationally, a practice aimed at reducing liquidity risks, but one that can also lead to financial crises.\(^74\)

and its subsidiaries can “obscure those assets and liabilities that are truly impacting the economic performance and financial position of the consolidated enterprise,” hide which entity is actually exposed to market risks, and lead to larger, more complex balance sheets that “can obscure individual amounts”).\(^71\)


\(^72\) The likelihood that a financial shock will spill over to other parts of the system is called “systemic risk.” See Hedge Funds, Systemic Risk, and the Financial Crisis of 2007–2008: Hearing Before the H. Comm. on Oversight and Gov’t Reform, 110th Cong, 3–4 (2008) (statement of Andrew Lo) (defining systemic risk as the risk of a “broad-based breakdown in the financial system, often realized as a series of correlated defaults among financial institutions, typically banks, that occurs over a short period of time and typically caused by a single major event”); Steven L. Schwarz, Systemic Risk, 97 GEO. L.J. 193, 204 (2008) (defining systemic risk as the “risk that (i) an economic shock such as market or institutional failure triggers (through a panic or otherwise) either (X) the failure of a chain of markets or institutions or (Y) a chain of significant losses to financial institutions, (ii) resulting in increases in the cost of capital or decreases in its availability, often evidenced by substantial financial-market price volatility”).

\(^73\) See BRUNNERMEIER, supra note 2, at 220 (describing financial crises that began with small incidents that spread into a system-wide crisis). The mechanism through which shocks get propagated throughout one or more financial systems is referred to as “contagion.” See generally Marcello Pericoli & Massimo Sbracia, A Primer on Financial Contagion, 17 J. ECON. SURVS. 571 (2003) (positing a theoretical framework for financial contagion); IDENTIFYING INTERNATIONAL FINANCIAL CONTAGION: PROGRESS AND CHALLENGES 3–4 (Mardi Dungey & Demosthenos Tambakis eds., 2005) (providing the definition of contagion, but stating that there is broad disagreement in the literature as to the actual parameters of the term); FRANKLIN ALLEN & DOUGLAS GALE, UNDERSTANDING FINANCIAL CRISSES 230–31 (2007) (describing twin crises involving banks and currency markets and summarizing the literature on this topic).

\(^74\) See Philippe Aghion et al., Contagious Bank Failures in a Free Banking System, 44 EUR. ECON. REV. 713, 715–17 (2000) (developing a global-coordination-failure model of contagion in which the failure of one bank can lead depositors to conclude that failure due to liquidity problems exists in the whole banking system); Franklin Allen & Douglas Gale, Financial Contagion, 110 J. POL. ECON. 1 (2000) (developing a model which predicts that interbank markets help decrease the probability of individual bank failure but increase the likelihood of financial contagion); see also FREIXAS & ROCHET, MICROECONOMICS OF BANKING 191 (1997) (distinguishing between a “bank run” affecting one bank and a “bank panic” affecting the whole
Finally, modern financial products are often created by combining two or more simpler contracts—or sets of promises—into a more complex one are by nature more difficult to understand and value.\textsuperscript{75} Competition among institutions\textsuperscript{76} can lead to the introduction of new, and increasingly complex financial contracts before they are properly stress tested to discover potential problems.\textsuperscript{77} These contracts often involve a larger number of parties who are interconnected with each other in manners that are difficult to discern.\textsuperscript{78}

III. RATIONAL IGNORANCE AND INTERMEDIATION

This Part begins by examining the collective action problem faced by financial actors entering into complex transactions: At an individual level it is often rational to transfer the informational risks to a third party and enter into the transaction “blindly”—i.e., without acquiring information about one or more material transactional risks. However, if a sufficient number of actors choose to transact blindly the group of financial actors within the system will be made worse off. The last section looks at the incentive of financial regulators to delay monitoring and disciplining financial institutions.

\textsuperscript{75} See Sanjeev Arora et al., Computational Complexity and Information Asymmetry in Financial Products 1 (Feb. 5, 2012), available at http://www.cs.princeton.edu/~rongge/derivatevlatest.pdf (unpublished manuscript) (“The practical downside of derivatives is that they are complex assets that are difficult to price.”).

\textsuperscript{76} See Josh Lerner & Peter Tufano, The Consequences of Financial Innovation: A Counterfactual Research Agenda, 3 ANN. REV. FIN ECON. 41, 78 (2011) (“Securitization was part of a larger set of innovations that constitute the so-called shadow banking system in which market-based financial intermediaries replaced traditional banks.”).

\textsuperscript{77} Untested and poorly understood financial products can threaten the reliability of existing risk management systems. If these systems are not updated in a timely fashion, they can give managers a false sense of security and lead them to enter into transactions that they would have avoided had they known about the true extent of the risks involved. One reason why investment banks may rush to market new financial products is that once a product becomes public other investment banks can copy it and sell it to their own clients. It is much more difficult to get effective intellectual property protection of financial innovations than it is for standard innovations. As a result, the first investment bank to reach the market with a new product will be able to acquire some market share and reputational capital before others copy its innovation. See Allen & Gale, supra note 74, at 45–56. It is, however, possible to get patent protection on some types of financial innovations. See State St. Bank & Trust Co. v. Signature Fin. Grp. Inc., 149 F.3d 1368, 1373 (Fed. Cir. 1998) (allowing patents on a financial innovation to consolidate information flow among group of mutual funds), abrogated by In re Bilski, 545 F.3d 943, 959–60 (Fed. Cir. 2008).

\textsuperscript{78} See COUNTERPARTY RISK MGMT. POLICY GRP. III, supra note 70, at 4 (describing the complexity faced by financial institutions in the day-to-day risk management of portfolios of complex securities).
A. THE TRADEOFF BETWEEN TRANSPARENCY AND "BLIND" HEDGING

A party entering into a financial transaction faces informational risks that it can deal with directly by acquiring information\textsuperscript{79} or indirectly by transferring the informational risks to a financial intermediary, which in turn will deal with those risks directly by screening and monitoring investments or by delegating to another intermediary, and so on. These risks transfers include a party’s purchasing of credit default swaps or entering into other types of hedging transactions. An actor will choose the direct route only to the extent that the net benefits from achieving greater transparency exceed the net benefits from hedging. In other words, a rational actor will invest in transparency only up to the point at which the marginal benefits of doing so equal marginal costs.\textsuperscript{80} All other things being equal, the greater the complexity the more likely that a party will choose to transfer the informational risk to an intermediary or find some other way of hedging.\textsuperscript{81} Similarly, the lower the costs of intermediation and hedging the more likely that a party will choose that route. At an extreme, a party can enter into a transaction fully informed or fully “blind,” or by choosing some combination of both.\textsuperscript{82}

The greater the number of parties involved in dealing with a particular informational risk, the greater the complexity and thus the greater the likelihood that parties will continue to choose to transfer the risk instead of trying to pierce through the complexity. That is, at some point, one would expect a financial system to reach a tipping point in which it becomes too expensive to deal with transactional risks through direct due diligence; and that at some further point down the line the number of “blind” transactions become so great

\textsuperscript{79} See Jack Hirshleifer & John G. Riley, The Analytics of Uncertainty and Information 200–06 (1992) (describing different approaches used by decision-makers for determining whether to acquire additional information before making a terminal choice and the value of potential information).

\textsuperscript{80} See, e.g., Jacob Marschak & Roy Radner, Economic Theory of Teams 85–86 (1972) (describing way of comparing different types of information structures to ascertain the value of information).

\textsuperscript{81} See generally Xavier Gabaix & David Laibson, Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets, 121 Q.J. ECON. 505 (2006) (discussing the general problems inherent in creating transparency when products have multiple attributes).

\textsuperscript{82} See Trole, supra note 26, at 15 (arguing that a party can address informational asymmetry problems in two nonmutually exclusive ways: aligning the interest of the other party with its own, or acquiring information to help it monitor and discipline the other party).
that those providing hedging services will either exit the market or charge much larger premiums. But a system with a sufficiently large number of “open” blind transactions can quickly become unstable.

This is because these blind transactions, while rational, at the individual level, will lead to aggregate informational deficits at the group level, a problem that is made worse the longer that a group of actors have relied on remaining rationally ignorant. The group of actors that comprise a financial system—such as financial institutions, nonfinancial firms, consumers, government borrowers, and regulators—are better off collectively if information about each of the systemically important participants is gathered, evaluated, and put to use in a timely fashion: before the system has experienced a sudden meltdown. Dealing with transactional risks using blind solutions, in short, can lead to systemic risk and financial crises.

B. INCENTIVE OF REGULATORS TO DELAY MONITORING FINANCIAL INSTITUTIONS

There are four principal reasons why regulators may choose to delay in monitoring and disciplining financial institutions. The first reason is regulatory capture. There is a large literature dealing with regulatory capture. The basic idea is that regulators, regulated parties, and the beneficiaries of the regulation find themselves in a repeat game with each other in which the regulated parties and regulators have an incentive to collude with each other at the expense of the protected parties. One explanation given for this sort of collusion is that protected parties are usually dispersed consumers who face a collective action problem in monitoring and disciplining regulators, while the regulated industry players are fewer in number and hold similar regulatory interests, both of which make it easier for them to collude with each other (which is the necessary first step before they are able to collude with regulators).

The second reason that regulators may delay monitoring and disciplining errant financial institutions is that they have limited budgetary resources. Moreover, during good economic times it is more likely that Congress will cut back on budgets meant to monitor and discipline financial institutions. One reason for this is that such expenditures may be deemed as wasteful because of a belief that aggressive regulatory monitoring will find nothing. A second reason is that aggressive enforcement can lead financial institutions to forego socially valuable risky behavior, something that can prevent good
projects from getting financed and new financial innovations making it to the market. Related to this is the incentive of regulated parties to use these “good times” to lobby for greater deregulation. In other words, in good economic times, “deregulation entrepreneurs” will have an incentive to expend resources to convince lawmakers and administrators either to deregulate outright or to under-enforce existing regulations. 83

A third reason why regulators may choose to delay disciplining financial institutions is that it can lead the regulator to suffer a reputation loss. When financial institutions are financial trouble, it is often difficult for third parties to determine whether the institution reached that state due to lax regulatory oversight or because while regulators did their job as best they could, managers were able to hide these problems the regulators. As a result, once the regulator finds out that the financial institutions is in a bad state it can either act immediately, which would yield an immediate reputational loss, 84 or delay publicly disciplining the institution. As long as there is a sufficiently high probability that the institution will be able to get past its current financial problems, both the regulator and the managers will have an incentive to delay—i.e., they will both have a valuable real option. Moreover, this general problem is exacerbated by the fact that the general fragility of financial institutions and possibility of a bank run provides additional justification for delaying making the financial problems public. The problem is that it is difficult for a third party to verify whether the regulator’s delay was due to her career concerns or to legitimate regulatory reasons.

A fourth reason for regulatory inertia is due not to actual strategic behavior by regulators but because of coordination failures

83. Some commentators have argued that after economic crises “regulation entrepreneurs” emerge who lobby for the adoption of new regulations. The underlying premise of many of these arguments is that these new regulations are unnecessary or ill-conceived, since they will be a rush to get them adopted. See, e.g., Roberta Romano, The Sarbanes-Oxley Act and the Making of Quack Corporate Governance, 114 YALE L.J. 1521 (2005) (making argument regarding regulation entrepreneurs). It is not at all clear why the problem is not a symmetrical one: During good times, well-financed industry lobbyists will have an incentive to act as deregulation entrepreneurs. This creates an important problem for any regulatory regime. It is impossible for those adopting the regulations in bad time to precommit to fully enforce them or not repeal them in good times. A rational regulated party will take into account this probability of under-enforcement and deregulation when choosing how to act during good economic times. This will lead to riskier behavior than would be rational in a world of regular or full enforcement.

84. The magnitude of this loss will depend on the regulator’s ability to credibly signal that the financial institution reached that state notwithstanding the fact that she engaged in proper oversight.
between multiple regulators. For example, financial institutions and derivative securities are regulated by multiple regulators. Whenever there are multiple regulators, there may be coordination failures due to beliefs that another regulator is actually taking care of the problem. In other words, it may be the case that each regulator is doing their job in properly regulating the institutions under their jurisdiction, but only to the extent that those institutions have no relationships with those regulated by other agencies. Once one creates the potential for these interconnections, then there is a need to have system-wide coordination between the various regulators. This general problem extends beyond regulators to other monitors. For example, if regulators believe that shareholders, creditors, and customers are actively monitoring the managers of financial institutions, they will conclude that they can exercise less oversight. However if each of these monitors believes this, then they will each have an incentive to free ride on the monitoring activities of the other. This collective action problem will lead to under-monitoring. As mentioned above these financial actors are less likely to monitor during good economic times. For example, Shareholders and creditors are more likely to conclude that actively monitoring managers will yield very little information of value. But unlike regulators, shareholders and creditors are able to exit the relationship once they find out that there are problems. Therefore they will have an incentive to delay starting their monitoring until they have received new information showing that there is a sufficient number of market participants who know that others know that the good times are coming to an end; that is, until it becomes common knowledge.85

IV. FINANCIAL MELTDOWNS DUE TO GROUP DYNAMICS AND STRATEGIC DELAYS IN DISCLOSING INFORMATION

This Part begins by analyzing two contexts in which financial institutions can suffer sudden liquidity and solvency problems, both of which depend on group pathologies. It then discusses the incentive faced by financial actors to delay disclosing information to others within the financial system. These strategic delays can in turn exacerbate the group pathology problems, given that these are driven by informational deficits faced by parties transacting with financial

intermediaries. The last section discusses two complexity issues that can exacerbate these group pathologies: the complexity associated with solving coordination problems, and that associated with legal rules and private governance mechanisms.

A. Banks and Bank Runs

Traditionally, commercial banks main business involved two types of transactions: borrowing funds from depositors, on a short-term basis, and using those funds to make loans to firms and households in need of capital.86 In making these loans, the bank acts as a financial intermediary, since it funds the loans using a portion of the depositors’ funds; the bank keeps the rest of the depositors’ funds on “reserve,” in case depositors want to withdraw them. While depositors can demand repayment immediately, whenever they want to,87 the bank cannot demand repayment of the principal before the end of the loan term unless the borrower has defaulted.88 By turning some of the depositors’ funds into illiquid assets—loans—the bank creates a potential liquidity problem: if all depositors decide to withdraw their funds at the same time, the bank will not have enough to go around.89 More generally, if a sufficiently large number of depositors believe, correctly or incorrectly, that other depositors believe that a bank is in financial distress and plan to withdraw their funds, they will try to win the race to the deposit window, in order to

86. See Freixas & Rochet, supra note 74 (defining a bank as a firm whose “operation consists in granting loans and receiving deposits from the public”). The Bank Holding Company Act of 1956 defines a “bank” as an “insured bank” under the FDIC Act or any institution organized under Federal or state law which both accepts demand deposits and is in the business of making commercial loans. 12 U.S.C. § 1841(c)(1) (2011). Under the FDIC Act, an “insured bank” is a state or federally chartered bank whose deposits are insured by the FDIC. 12 U.S.C. §§ 1813(a) and (h) (2011).

87. The standard type of bank account is a “demand deposit” account, which allows the depositor to withdraw funds from the account by making an appropriate request to the bank. See 12 C.F.R. § 204.2(b) (2009) (defining a “demand deposit” as a deposit with a bank that is payable on demand).

88. See Gary Gorton & Andrew Winton, Financial Intermediation, in 1A HANDBOOK OF THE ECONOMICS OF FINANCE 430, 435 (George M. Constantinides et al. eds. 2003) (describing the differences between securities issued to borrowers and lenders).

89. If a federally insured depositary institution, such as a bank, becomes insolvent, the customer’s deposits will be protected by the Federal Deposit Insurance Corporation, up to a pre-defined amount. See Deposit Insurance Regulations; Permanent Increase in Standard Coverage Amount; Advertisement of Membership; International Banking; Foreign Banks, 75 Fed. Reg. 156,49,363 (Aug. 13, 2010) (to be codified at 12 C.F.R. pt. 330), https://www.federalregister.gov/articles/2010/08/13/2010-20008/deposit-insurance-regulations-permanent-increase-in-standard-coverage-amount-advertisement-of.
assure that they can get their money out before the bank runs out of funds. This sort of behavior will trigger a "bank run." In order to reduce the risks of insolvency and bank runs, bank regulators provide depositors with insurance through the FDIC and banks with access to the Federal Reserve's discount window, from which they can borrow funds. They also subject banks to monitoring, prudential regulations, and minimum capital requirements, all of which have the effect of limiting a bank's leverage, total loan exposures, and ability to expand into nonbanking businesses.

Before the advent of securitization and loan participations, a bank's loan portfolio was a relatively illiquid asset. But the liquidity

90. See Douglas W. Diamond & Philip H. Dybvig, Bank Runs, Deposit Insurance, and Liquidity, 91 J. POLITICAL ECON. 401, 401 (1983) (defining a bank run as a situation in which "depositors rush to withdraw their deposits because they expect the bank to fail"). See also FRANKLIN ALLEN & DOUGLAS GALE, UNDERSTANDING FINANCIAL CRISIS 94-96 (2007) (summarizing the literature on bank runs).

91. There are two important institutional features of banks that can increase the risk of a run: the fractional reserve system and the "first-come, first-served" policy for depositors wishing to withdraw their funds. The latter creates a sort of race-to-the-deposit-window that can lead to bank runs, notwithstanding the fact that the bank is actually in good financial health. See Jean-Charles Rochet, Bank Runs and Financial Crises: A Discussion, in CREDIT, INTERMEDIATION, AND THE MACROECONOMY: MODELS AND PERSPECTIVES 324, 324-325 (Sudipto Bhattacharya et al. eds., 2004) (arguing that fractional reserve system is principal reason for general fragility of banks); Yehning Chen, Banking Panics: The Role of the First-Come, First-Served Rule and Information Externalities, 107 J. POL. ECON. 946, 947-949 (1999) (discussing the repercussions of the first-come first-serve system on bank runs and bank panics more generally).

92. Deposit insurance provides the main line of defense against bank runs. If depositors know that their deposits are protected they will no longer withdraw their funds merely because of a fear that the bank will run out of funds. See Diamond & Dybvig, supra note 90, at 413-16. A bank run may nonetheless be socially beneficial if it leads to the dissolution of an insolvent bank that has no positive value as a going concern. See Itay Goldstein & Ady Pauzner, Demand–Deposit Contracts and the Probability of Bank Runs, 60 J. FIN. 1293, 1295 (2005) (contrasting efficient and inefficient bank runs).


97. See FREIXAS & ROCHET, supra note 74, at 272-74 (discussing regulatory capital requirements).


provided by the selling loans and through other types of short-term borrowings, such as repos, can quickly dry up if the securitization, loan participation, and repo markets contract quickly, as they did in 2007 and 2008.

As a result, an important part of risk management of banks is trying to predict how the inflow and outflow of deposits and loan proceeds may vary at different points in the future. This includes trying to anticipate changes in the business cycle and other macroeconomic shocks\(^\text{100}\) and in the riskiness of the bank’s deposit and loan portfolios, including liquidity shocks to consumers and businesses and reductions in the value or liquidity of collateral on which the bank is overly dependent (e.g., mortgages).\(^\text{101}\) After the freezing of the repo and securitization markets in the 2007–2008 financial meltdown, and the adoption of the Dodd-Frank Act,\(^\text{102}\) federal regulators require banks and other financial institutions\(^\text{103}\) to adopt risk management practices that take into account all sources of

\(^{100}\) See Anil K. Kashyap & Jeremy C. Stein, Cyclic Implications of The Basel II Capital Standards, ECON. PERSPECTIVES 18, 21 (Federal Reserve Bank of Chicago) (1st Quarter, 2004) (arguing that instead of setting capital requirements based on a single, static risk curve, regulators should instead use “a family of point-in-time risk curves, with each curve corresponding . . . to different macroeconomic conditions”).

\(^{101}\) See Evan Gatev, Til Schuermann & Philip E. Strahan, Managing Bank Liquidity Risk: How Deposit-Loan Synergies Vary with Market Conditions, 22 REV. FIN. STUDIES 995, 1000-03 (2009) (summarizing literature on relationship between bank depositors and borrowers, particularly during changes in business cycle that can affect value of loan portfolio).


\(^{103}\) Investment banks, insurance companies, hedge funds, mutual funds, and finance subsidiaries of business firms are all examples of firms whose business have some banking characteristics—making loans or taking deposits—and are thus known as “shadow banks.” Investment banks and finance subsidiaries either make loans or routinely enter into transactions that are the functional equivalent of a loan. Additionally, clients of mutual funds, investment banks, and insurance companies can open money market accounts that are very similar to the demand deposit accounts of banks. However, until the adoption of the Dodd-Frank Act, shadow banks are not subject to the capital requirements and prudential regulations of federal banking statutes, either because they do not own a chartered bank or insured institution or because they fall under some other regulatory exemption. This in turn gave shadow banks a competitive advantage over commercial banks, and forced the latter to adopt riskier business practices in order to effectively compete with other institutions. See Hedge Funds, Systemic Risk, and the Financial Crisis of 2007–2008: Hearing Before the H. Comm. on Oversight and Gov’t Reform, 110th Cong. 4 (2008) (statement of Andrew Lo) (describing shadow banking system); Gary Gorton, Bank Regulation When “Banks” and “Banking” are Not the Same, 10 OXFORD REV. ECON 106, 111-13 (1994) (describing result on bank behavior from increased competition from shadow banks and arguing that given that many nonbank financial institutions engage in the types of activity usually carried out by regulated banks, one needs to adopt functional regulations that track “banking activities”).
funds\textsuperscript{104} that can dry out quickly\textsuperscript{105} due to disruptions in markets\textsuperscript{106} or the failure of systemically important institutions.\textsuperscript{107}

B. DEMAND DEPOSITS VS. REPOS

A demand deposit is a loan from a depositor to the bank with an infinitesimally small maturity: It is rolled over automatically, second-by-second,\textsuperscript{108} until the depositor cancels the loan. Additionally, as we have seen, demand deposits are insured by the FDIC, which in essence collateralizes the loan with a claim against the government for the insured amount.\textsuperscript{109} As long as the depositor keeps within the insured limits, it can lend money to a bank blindly, without screening it ex ante or monitoring it ex post.\textsuperscript{110} In the period leading to the financial meltdown of 2007–2008, it became increasingly popular for both insured and non-insured institutions to borrow on a short-term basis, without having to build an insured depositor base. A principal

\begin{itemize}
  \item \textsuperscript{104} Dodd-Frank Act § 165(b)(1)(A) (requiring the Federal Reserve to adopt heightened prudential standards for systemically important institutions, including risk-based capital requirements and leverage limits, liquidity requirements, risk-management requirements, resolution plan and credit exposure report requirements, and concentration limits).
  \item \textsuperscript{105} Dodd-Frank Act § 165(b)(1)(B) (authorizing Federal Reserve to adopt heightened prudential standards to deal with sudden changes in an institution’s sources of capital, including contingent capital requirements and short-term debt limits).
  \item \textsuperscript{106} Dodd-Frank Act § 112(a)(1) (describing duties of Financial Stability Council to include making recommendations to primary financial regulatory agencies to apply new or heightened standards and safeguards for financial activities or practices that could create or increase risks of significant liquidity, credit, or other problems spreading among bank holding companies, nonbank financial companies, and United States financial markets”).
  \item \textsuperscript{107} Dodd-Frank Act § 102(a)(1), (a)(4)(A) (defining “bank holding company” and “foreign nonbank financial company,” respectively); \textit{id.} § 102(a)(4)(D) (defining “nonbank financial company supervised by the Board of Governors” as a nonbank financial company that the Financial Stability Oversight Council has determined shall be supervised by the Board of Governors); \textit{id.} at § 102(a)(7) (delegating to the Federal Reserve Board the authority to define “significant nonbank financial companies” and “significant bank holding companies”).
  \item \textsuperscript{108} With the advent of automated banking, depositors have access to their funds at any time; although for security reasons, banks imposed limits on withdrawals from ATMs during off-hours, the depositor with access to online banking can always transfer all of its funds from one institution to another. While the wire transfer may not occur instantaneously, the main point remains: A depositor can withdraw its liquidity from the bank at any point, with a few possible delays due to the reasons mentioned.
  \item \textsuperscript{109} See Diamond & Dybvig, supra note 90, at 402–03.
  \item \textsuperscript{110} A depositor who needs instant liquidity and cannot wait for the FDIC to pay out the insurance may still bear some counterparty risk and will weigh the costs of doing some minimal monitoring against those of diversifying its funds by opening accounts with different banks. Given the limits imposed by the FDIC insurance, wealthy households already do this. See Lawrence M. Benveniste & Allen N. Berger, Securitization with Recourse: An Instrument that Offers Uninsured Bank Depositors Sequential Claims, 11 J. BANKING & FIN. 403 (1987) (discussing how large account holders can protect themselves by diversifying their deposits across banks).
\end{itemize}
borrowing source is the repo market, which allows financial institutions to raise short-term funds using securities as collateral.

In a repo, the “borrower” sells a security to the “lender,” agreeing to repurchase it at some point in the future. The two agreements are structured so that a repo is functionally equivalent to a short-term secured loan, with the security acting as collateral. The collateral may range from relatively safe and liquid securities, such as Treasury bills, to riskier ones, such as asset-backed securities. If the borrower defaults on her repurchase obligation, the lender will sell the security and thus bears the risk of a decline in value or an inability to resell. In order to deal with this risk, a repo lender can demand additional collateral or higher, both which will reduce the borrower’s ability to increase her leverage. This in turn may put a borrower at a disadvantage vis-à-vis other financial firms that can achieve a greater amount of leverage. Alternatively, the lender can demand a shorter maturity. If the maturity is sufficiently short, any marginal gain from actively monitoring the lender or collateral will disappear, and the repo will turn into a blind-debt instrument. For example, suppose that a hedge fund has a security with a current market value of $1,000 and wants to borrow money in the repo market. A repo seller owning a security valued at $1,000 can sell it to the repo buyer for $900, agreeing to repurchase it at a later date for $1,000. The $100 difference between the sale and repurchase price is


111. The “borrower” is known as the repo seller; the lender of buyer of the repo is in turn entering into a “reverse repo.” See Peter Hordahl & Michael R. King, Developments in Repo Markets During the Financial Turmoil, BIS QUART. REV. 37, 38–39 (Dec. 2008) (describing basic characteristics and uses of repo transactions).
112. Repos are structured as a sale of the security in order to protect the buyer from the bankruptcy trustee of a seller. If the borrower goes into bankruptcy during the term of the repo, the collateral does not become part of the bankruptcy estate because the lender already owns it. This is different than if the transaction had been structured as a loan secured by the security. See Section 559 of Bankruptcy Code, 11 U.S.C. § 559 (2005) (main section exempting repo from automatic stay); 11 U.S.C. § 362(b)(7) (2010) (stay not applicable to exercise of contractual rights by repo participant).
113. See Hordahl & King, supra note 111, at 37–38 (describing flight to safer, more liquid collateral).
115. See Hordahl & King, supra note 47, at 40–41 (describing the risks associated with repo defaults in the face of changing market conditions).
116. One of the reasons why shadow banks have a competitive advantage over traditional banks is that banking regulations limits how much a bank can leverage itself. See Financial Crisis Hearing, supra note 40, at 10–11 (statement of Andrew Lo) (discussing advantage of hedge funds that are able to leverage selves much more than traditional banks).
the haircut, equivalent to a cash margin but higher, because the collateral may lose value before the repurchase date. On that date, the parties can either settle the repo or roll it over.

One would expect that a repo lender who feels insecure will have an incentive to make changes to reduce her risk exposure. She will reduce the maturity and, if she still feels insecure, she will raise the haircut on existing collateral and, if need be, require safer collateral, such as Treasury bills. Finally, if after making these adjustments, the lender still feels too exposed to credit risk, she will not renew the repo. It follows that, as the short-term collateralized credit market begins to feel insecure en masse, this same dynamic will eventually turn repos into the equivalent of a demand deposit, with the important exception that they will not be insured by the FDIC. In other words, a demand deposit will roll over each day automatically, but a depositor can refuse to renew the debt by withdrawing her funds. Before FDIC insurance, this opened banks to bank runs. Financial institutions using overnight repos equally depend on lenders renewing their loans each day and can suffer the same types of runs.

C. RUNS REVISITED

Bank runs and runs on repos are both caused by informational asymmetries among depositors and repo lenders, respectively, and their knowing that each of their welfare is affected by what others choose to do. This leads to the type of group dynamics problems discussed supra Part II. I will develop the general arguments in connection with runs on repos, but the same type of argument applies to runs on banks. There are two general types of scenarios. Under both, \( n \) parties are interconnected—their behavior can affect the welfare of the others within the group. This interconnection is created via their individual relationships with a financial institution. Under one scenario, the parties all act simultaneously—in the sense that at the time that they decide to act, they are unaware of what the other parties are up to. For example, each depositor has two types of actions available to it: to keep its money in the bank or withdraw it. Each depositor will try to predict what others will do and will adopt the same strategy. Because they cannot observe what others are up to until it is too late, the depositors will need to err on the side of caution, particularly if they at all believe that the others are in the process of withdrawing their funds. Under a second type of scenario, the informational asymmetry among the parties is different: a party
will observe a second party doing something, such as withdrawing funds from a bank. The observing party will have a piece of information—a withdrawal has occurred—and must interpret that action: it must determine the reason why the party has acted in the way that it did. For example it may conclude that the other party is withdrawing funds to pay her taxes or college tuition; alternatively, it may conclude that the other party knows that the bank is in financial distress. If the observer reaches the second conclusion, it too will withdraw its funds. Now if a third party observes the first two withdrawing funds it may conclude that the first two are worried about the bank’s financial health and withdraw its funds. And so on. Both the first scenario—a coordination failure—and the second—herding behavior—can lead to bank runs; they can also lead to runs on repos. In the rest of this section I will further elaborate on these two types of group dynamics, in the context of repos.

1. Coordination Failure Explanation of Run on Repos

In the normal course of business, repo lenders are in an equilibrium position in which they believe that it makes sense to renew the repo for one more day. A run will occur when those beliefs change, and lenders converge to a new equilibrium, in which the best strategy is not to roll over the repo. That is, repo lenders are involved in a coordination game\textsuperscript{117} with two equilibriums: Under one the lenders have confidence that the borrower will repurchase the repos (the “optimistic equilibrium”); under the other, they believe that the borrower will default and they will all try to sell the collateral in a fire

\textsuperscript{117} One commonly used example of a coordination game involves two players choosing whether to go to one of two events; they are unable to communicate ahead of time so to make sure that they both choose the same event. If one chooses event A and the other chooses event B, or vice versa, they are both worse off. On the other hand, if they both end up doing A or B they each are better off. It may be that one player prefers A to B, but they both prefer to end up in the same event as opposed to not spending the time together. Finally, since both player choose their actions simultaneously—i.e., they cannot coordinate their behavior by communicating or waiting to see what the other does—each will try to predict what the other will do. As a result, there are two possible equilibriums to their coordination problem. Since they each prefer both doing A or both doing B, but not any other alternative, and therefore would not want to deviate from either equilibrium. Suppose that both players prefer the A-A equilibrium over the B-B one. If they both end up doing B, their actions can be deemed to be a coordination failure since their joint payoffs will be lower. For a formal discussion of the coordination game, see DREW FUNDENBERG & JEAN TIROLE, GAME THEORY 18–20 (1991) (describing coordination game and showing that it has two Nash equilibriums); RUSSELL W. COOPER, COORDINATION GAMES: COMPLEMENTARITIES AND MICROECONOMICS viii–xiii (1999) (discussing coordination failures in which the behavior of players leads to suboptimal equilibrium).
sale, making them all worse off (the “pessimistic equilibrium”).

Under the coordination game, the lenders’ decisions occur simultaneously. When they each decide whether or not to rollover their repos, they do not know what the other lenders have done. Lenders may thus switch from the optimistic to the pessimistic equilibrium if a sufficient number of them believe that others will not renew their repos, since those who do will end up as creditors to an insolvent financial institution or one without the liquidity to repurchase the repos. Nonetheless, if the bank is in good financial health, then the optimistic equilibrium is the preferred one. If depositors’ beliefs about what others will do have changed, they will all switch to the suboptimal equilibrium in which they trigger a bank run and the healthy bank becomes insolvent.

The coordination explanation of repo runs captures one dimension of the way in which the fates of repo lenders are intertwined: A decision of one group of lenders to withdraw their liquidity will harm those who agree to continue to provide the borrower with funds for at least one more period. Another way of saying this is that some of the costs and benefits flowing from a repo lender’s decision to stick to the status quo or to withdraw liquidity will impact the welfare of other lenders. This payoff externality will be present both in cases in which lenders act simultaneously and those in which they move sequentially; however, when repo lenders act sequentially, the earlier movers will also provide an informational externality to later movers. This informational externality can lead to repo runs due to herding behavior.

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118. This is the same setup as the bank run model developed by Diamond and Dybvig. See Diamond & Dybvig, supra note 90, at 401 (classic treatment setting forth multiple equilibriums model of bank runs, including role played by coordination failures and self-fulfilling beliefs).

119. Since the players have to decide what to do without having the benefit of waiting to see what the others have done and without the ability to communicate, in order to achieve coordination each player has to correctly predict what the others will do. In real world scenarios, actors will try to use other information in order to predict what the others will do. To the extent that they each has access to the same salient information or signal, it may act as a “focal point” that will allow them to coordinate their actions. See THOMAS C. SCHELLING, THE STRATEGY OF CONFLICT 54, 57 (1960) (stating that for players to achieve coordination they have to “read the same message in the common situation, to identify the one course of action that their expectations of each other can converge on. They must ‘mutually recognize’ some unique signal that coordinates their expectations” and describing such a salient or prominent signal as a “focal point”).

120. See BRUNNERMEIER, supra note 2, at 147 (drawing distinction between payoff externalities in which later movers receive higher payoffs by mimicking actions of earlier movers, and informational externalities, in which the actions of these earlier movers provides information to later movers).
2. Repo Runs Due to Herding Behavior

Whenever, two actors are making the same type of decision and one of them acts first, the second actor engages in "herding behavior" if she mimics the first actor's behavior, notwithstanding the fact that if she solely relied on her own private information, she would have acted in a different manner. In order to economize on information costs, rational actors often choose to rely not just on their own private information but also on the inferences that they draw from observing the behavior of actors who are involved in making the same type of decision. Since there is usually more than one possible rationale that would explain the behavior of others, these "signals" are subject to error costs due to the observer misinterpreting it. That notwithstanding, this expected error cost may be lower than the cost of acquiring the information directly.

To see how herding behavior can lead to a repo runs, assume that there are three lenders. Lender 1 decides not to renew the repo and upon observing this, Lender 2 does the same, believing that Lender 1 acted on private information that either the borrower was in financial trouble or the collateral was worth less than the face value of the repos. Now Lender 3, upon observing the behavior of the first two is even more likely to conclude that they refused to renew their repos because they knew something. Notice that except for Lender 1, the others made their decisions using only one piece of information: the fact that they saw other Lenders pulling their liquidity.

However, there are a number of reasons why a lender may decide not to rollover a repo: (1) it has private information that the borrower is in financial stress or that the collateral is overvalued; (2) the lender is facing its own financial difficulties; or (3) the lender is aware that other financial institutions are in poor health. Herding behavior based on the first explanation is optimal if it leads to the

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121. See A. V. Banerjee, A Simple Model of Herding Behavior, 107 Q. J. ECON. 797, 798 (1992) (developing herding model in which actors merely mimic actions of others notwithstanding fact that if relied on own information alone, it would lead to her to act differently). In some extreme cases, the second actor mimics the first one without paying any attention to her own private information and act in the same exact manner as the first actor. See BRUNNERMEIER, supra note 2, at 148–49 (discussing this more extreme form of herding, usually referred to as an informational cascade).

122. See BRUNNERMEIER, supra note 2, at 28 (drawing distinction between traders who sell assets due to own private reasons and those who sell for common reasons, such as private information that the assets are overvalued).
failure of the poorly performing institution; however, herding based on the other two explanations can lead to the inefficient failure of an otherwise healthy institution. However, as a general matter, a later moving lender will not know why the first lender decided not to renew the repo, and it is this informational asymmetry that can lead to inefficient herding.  

3. Conclusion

In both explanations of repo runs, even a slight doubt as to the value of widely used collateral could cause lenders to exit the market so as not to be caught in a fire sale with other holders of the same collateral. The problem is even greater for collateral that has no real market and no way of ascertaining its true value or other’s willingness to purchase it in the midst of a panic. Those holding this sort of highly illiquid collateral depended on the financial institution surviving one more day. But this in turn required that other repo lenders believed the same thing and thus would agree to renew their repos for one more day. For example, the Lehman bankruptcy report shows in great detail that a large reason for Lehman’s sudden collapse was its reliance on the repo market and the refusal of some lenders to continue to rollover repos, given the increasing uncertainty about the value of the assets that Lehman had available for collateral. While in theory, a run on a poorly performing institution may make society better off by redistributing assets to more valuable projects, given the connection between financial institutions, a run on such an institution can lead to suboptimal results from a system-wide perspective.

123. See V. V. Chari & Ravi Jagannathan, Banking Panics, Information, and Rational Expectations Equilibrium, 43 J. Fin. 749 (1988) (setting forth a bank run model in which a sufficiently large set of individuals withdraw at the same time for private reasons not necessarily related, and these withdrawals are observed by others that infer that those withdrawals are due to liquidity problems in that bank).


125. For example, a bank run may nonetheless be socially beneficial if it leads to the dissolution of an insolvent bank that has no positive value as a going concern. See Itay Goldstein & Ady Paouner, Demand–Deposit Contracts and the Probability of Bank Runs, 60 J. Fin. 1293, 1295 (2005) (contrasting efficient and inefficient bank runs).
D. OTHER RISKS OF RELYING ON REPOS AND OTHER FORMS OF SHORT-TERM DEBT

Firms that rely heavily on short-term financing open themselves to a risk that creditors will refuse to continue to rollover the debt. There are three principal reasons why this may happen. First, the borrower has defaulted on an existing debt or some other information has reached the market indicating that rolling over the debt in its previous form would be too risky. The lender may refuse to roll over the debt, raise the interest rate, demand additional collateral, or impose more onerous covenants. Second, even though the borrower is in sound financial health, the lender may no longer have the ability to rollover the loan. This may be because the lender is a financial institution that receives its funds from an investor who has withdrawn its capital. For example, the lender may be a bank who no longer has sufficient capital to lend because a sufficient number of depositors have withdrawn their money and the bank cannot meet its regulatory capital requirements.

Third, even though both the borrower and lender are in good financial health, other lenders and borrowers may be experiencing financial difficulty. There are two reasons why this may affect the transaction between the otherwise financially healthy borrower and lender. First, the lender may not know whether the financial difficulties faced by other lenders is based on private information about the market or economy that it is not privy too—i.e., the lender may be in the same poor financial position, or not, but in any case is uncertain about it. As a result, it may act prudently and delay making additional loans until it can resolve this uncertainty. The lender may also be worried about a contagion or spillover effect. That is, if other lenders and borrowers are experiencing difficulty, this can lead to a reduction in lending opportunities, greater costs of raising capital in debt and equity markets, or fewer risk-sharing opportunities with

126. Credit agreements are usually interconnected either expressly or implicitly in one important way: The existence of one default can trigger other defaults in credit transactions with other creditors. Many loan agreements contain cross-default provisions. Under such a provision, the debtor is deemed to be in default not because it has breached a provision in the agreement in question, but because they have breached another loan agreement.

127. This is an example, of what economists refer to as a real option: given the uncertainty, it may make sense for the lender to delay making an irreversible decision, until it has acquired information that resolves this uncertainty. See AVINASH K. DIXIT & ROBERT S. Pindyck, INVESTMENT UNDER UNCERTAINTY 6–7 (1994) (discussing the value of an option of delaying making a decision that is costly to reverse when there is still uncertainty about how the future will unfold).
other financial institutions.

Even if the lender is not worried about its incomplete information of what is ailing other lenders and borrowers or of spillover effects, its decision to rollover an existing loan agreement can be affected by a second type of informational problem: It does not know whether the borrower is in fact a “good” one or one that is also experiencing financial difficulties. When the number of known “bad” borrowers increases, the lender will have to revise its assessment of the probability that it too may be dealing with a bad borrower who is able to dissimulate its true financial position. This leads to a standard adverse selection or market for lemons problem. The lender will now perceive a greater risk that it is dealing with a bad borrower and will either not rollover the debt, increase the interest rate, or protect itself more thoroughly through loan covenants or collateral.

E. Strategic Delays in Making Disclosures

Given the general fragility of financial institutions, the disclosure of bad news can have a greater effect on the continuing viability of the institution than on business firms, which are more robust to the revelation of material changes in the operations and results of the company. Some business firms are closer to financial institutions, in that they can unravel quickly and fail upon the disclosure of unexpected bad news: One example is innovation intensive start-ups whose principal assets are intangible and difficult to value, pledge, and sell, such as intellectual property and the human capital of the founders.¹²⁸ From a social welfare maximizing perspective, one would want financial institutions and business firms to survive if they have a positive going-concern value: If the net present value of the expected future cash flows (discounted to take into account the risk-free interest rate, and other sources of impatience, and the risk associated with the actual gross returns) are positive.¹²⁹

¹²⁸ Because of this, standard venture capital contract contain provisions to protect venture capitalists against the risk of a start-up's sudden failure. See Manuel A. Utset, Reciprocal Fairness, Strategic Behavior & Venture Survival: A Theory of Venture Capital-Financed Firms, 2002 Wis. L. Rev. 45 (2002).

¹²⁹ See THOMAS H. JACKSON, THE LOGIC AND LIMITS OF BANKRUPTCY LAW (1986) (explaining the role of bankruptcy law in helping protect firms with positive going-concern value from a quick unraveling due to creditors racing to grab assets before others are able to do so).
1. Managers' Incentive to Delay Disclosing Bad News

There are five principal reasons why the manager of a financial firm may delay disclosing to regulators and the market that the firm is facing financial difficulties. First, disclosure can lead the manager to suffer an immediate loss that she may be able to avoid if the firm’s prospects turn around. If the manager owns stock options, the disclosure may lead to a drop in the stock price and thus the value of her options. The second reason why a manager may choose to delay making a disclosure is that the disclosure may affect her reputation as an effective manager, which can in turn negatively affect her future employment prospects. This second reason is usually referred to in the economics literature as “based on career” concerns. Third, disclosure may lead regulators to step up their monitoring activity or to require the firm to increase its regulatory capital. The latter will constrain the 'ability of the manager to undertake riskier transactions of the sort that are more likely to allow the firm to get out of financial trouble (it can also lead the firm’s prospects to worsen by a much greater amount). Fourth, because of the contractual interconnections between financial institutions, a firm that is in financial trouble may choose to delay making disclosures to the capital markets or to regulators (if there is possibility that the disclosures will leak out or that regulators may alert the other financial institutions). Fifth, to the extent that the financial intermediary is being financed with short-term debt, it will want to delay alerting creditors about the problems since it would give them an incentive not to roll over the debt.

2. Incentive to Delay by Other Firm Participants

Some parties will have an incentive to collude with managers to delay disclosures; these include shareholders, subordinated debt-holders, long-term lenders, and employees. While each of these parties would individually want to find out about the firm’s financial troubles, they would want to only as long as that disclosure remained

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130. This incentive of subordinated debt-holders to collude with managers to delay having other creditors, shareholders, and regulators find out about the firm’s true financial state is important because some commentators have proposed that banks should be forced to borrow more from subordinated debt-holders. The general idea is that these debt-holders will have a better incentive than depositors to monitor bank managers. See, e.g., George Pennacchi, A Structural Model of Contingent Bank Capital (Federal Reserve Bank of Cleveland, Working Paper No. 10-04, 2010), available at http://business.illinois.edu/finance/papers/2010/pennacchi.pdf (discussing role of subordinated debt as contingent capital).
private information. But company disclosures under the Securities Exchange Act of 1934 and the Securities Act of 1933 are public goods: Even though the disclosures are for 'the primary use of shareholders, other parties cannot be prevented from getting access to disclosure documents filed with the Securities and Exchange Commission.\textsuperscript{131} Even if shareholders were the only ones who had access to the company’s disclosure, once they get that information they will have an incentive to trade on it, which will lead to it being indirectly disclosed to the rest of the world.\textsuperscript{132} While in theory, shareholders may be better off if they all agreed not to trade on the information as long as there is a positive option value from delaying the release of the information, they face a collective action or prisoner’s dilemma problem in which they will each be better off individually defecting and acting on that information.\textsuperscript{133}

Subordinated debt-holders are in a slightly better position as long as the company can make private disclosures to them. However, they face a similar collective action problem: They will each have an incentive to unwind their positions, but doing so will send a signal to the rest of the market that the debt-holders have private information about the firm’s financial state. To the extent that there is no active market for the subordinated debt and the group is small enough, subordinated debt-holders may be able to overcome the collective action problem and agree to delay taking any action that will allow other market participants infer their private information.\textsuperscript{134}

\textsuperscript{131} There are some exceptions in which the SEC allows a company to file documents that remain secret from everybody, including shareholders. On confidential filings, see Security Act of 1933, 17 C.F.R. § 230.406 (2013) and the Securities Exchange Act of 1934 17 C.F.R. § 240.24b-2 (2013).


\textsuperscript{133} For a discussion for why a similar dynamics increase the difficulty of institutional investors in forming voting coalitions to discipline managers, see Manuel A. Utsel, Disciplining Managers: Shareholder Cooperation in the Shadow of Shareholder Competition, 44 EMORY L.J. 71, 101–14 (1995) (arguing that in order to form coalitions, institutional investors will need to disclose private information that they can otherwise use to make an arbitrage profit at the expense of other institutional investors; and that problem is exacerbated by the fact that whenever an investor discloses private information, other investors will be unable to verify that it is truthful and meant to help form coalition as opposed to making an arbitrage profit).

\textsuperscript{134} For a discussion of the role of small groups in overcoming collective action problems see MANCUR OLSON, THE LOGIC OF COLLECTIVE ACTION (1965) (setting forth the classical treatment of the problem, and in emphasizing the role of group size in overcoming collective action problems); Thomas C. Schelling, Hockey Helmets, Concealed Weapons, and Daylight Saving: A Study of Binary Choices With Externalities, in MICROMOTIVES AND MICROBEHAVIORS 211, 217–18 (1978) (describing size of group required to overcome collective action problem).
Since employees in financial institutions often have compensation packages that include stock options, to the extent that they have shares that they are able to sell, they will face the same collective action problem as other shareholders. Their behavior will thus signal to the market that the firm is doing poorly. Employees will send an even more salient signal if they begin to leave the firm en masse. An employee who finds out that her employer is doing poorly will have an incentive to find a new job before too many other employees try to do the same thing and before the market finds out about the problem. An outside employer who finds out that the employee’s firm is doing poorly will discount for the risk that the employee is at least partially responsible for the firm’s problems. All thing being equal, the new employer will perceive a greater amount of risk if the employee is a manager or has broad supervisory responsibilities. But in financial institutions, the actions of even relatively low-level employees can have a disproportionate effect of the firm’s finances. Additionally, employees in financial institutions often work in teams, an institutional feature that makes it more difficult for outsiders to determine which team members are primarily responsible for bad results.

3. Collective Incentive of Financial Intermediaries to Delay Disclosure of Problems

Because of the informational asymmetries between financial institutions, and the risk of disclosing a problem before others, financial institutions will have an incentive to delay as much as possible letting the world know about their collective problem. If the financial firm in trouble is sufficiently interconnected with another financial firm, then the second firm will have an incentive to delay disclosure of the financial troubles until it has had sufficient time to unwind its position with the troubled firm. This is of particular importance when the troubled firm is acting as a counter-party to a derivatives contract, since the firm’s failure would lead to a breach of


136. For a discussion of the problems that arise in monitoring individual performance when the individual is part of a team, see Armen A. Alchian & Harold Demsetz, Production, Information Costs, and Economic Organization, 62 AM. ECON. REV. 777, 778–83 (1972); see also Roy Radner, Team Decision Problems, 33 ANNALS MATHEMATICAL STAT. 857 (1962) (analyzing how a team of decision-makers working within a firm, but with differing responsibilities and information, reaches collective decisions).
that contract. Moreover, to the extent that it is difficult for one intermediary to know the extent to which a second intermediary is interconnected with other intermediaries. Suppose that firm A is in derivatives contracts with firms B and C and that firms B and C are in a similar relationship with each other. If firm A knows that firm B is in trouble and is unaware of B’s connection with C, then if firm A withdraws funds from firm B, firm B may be forced to withdraw funds from firm C, something that may lead firm C to withdraw funds from A. This sort of domino effect is a common way in which financial contagion gets propagated among financial intermediaries.

As financial institutions and regulators begin to sense growing problems within the industry, problem-free financial institutions will have an incentive to curb their dealings with other institutions. First, they may be unable to tell the whether they are transacting with an institution in financial trouble. Second, the problem-free institutions do not want to send negative signals to regulators and investors. In other words, it is the problem institutions that will be the most eager to continue to enter into risky transactions: If they do not work out, they will not necessarily be much worse off than before; but if the transactions pay off they may be able to get over their ongoing problem. Therefore, since problem institutions are the ones who are most likely to want to enter into transactions, the good firms will exit the market so as not to be confused with the problem firms. As a result, only problem firm will be left in the marketplace, and if they continue to transact with each other, they will have a greater risk that things will fall apart rather quickly. At the end of this whole cycle, a financial crisis may emerge out of “nowhere” and “spread quickly,” but that is not what happened at all. Such a financial crisis built up over time, insidiously, and when it was finally revealed to the world, it may appear to some to be like a brushfire that quickly got out of control. But this insidious contagion is best analogize to the slow build-up of plaque in a person’s arteries: At some point in time, a relatively small shock to the system can trigger a heart attack, but the real problem was already in place and waiting to occur.

F. COORDINATION, GOVERNANCE, AND COMPLEXITY

The ability of actors to coordinate their behavior will depend on the complexity of the environment in which their cooperative activities take place. Coordination will become more difficult to the extent that actors have incomplete information about each other and
their environment. The problem is further exacerbated if their behavior is guided by complex legal rules and contracts. More generally, the ability of parties to avoid coordination failures and inefficient herding will depend, in part, on the complexity of the problem: the number of parties involved and the manner and number of channels through which they are interconnected with each other; the various ways in which an the observed action of one party—such as depositor’s withdrawing funds from a bank or a repo lender’s asking for more collateral or refusing to rollover a repo.

In designing governance rules regulators and private parties have to confront another complexity constraint: the complexity of governance regimes themselves. One source of governance complexity is that associated with introducing additional actors into a system. For example, a regulator considering a legal rule to increase the transparency of corporate disclosures will need to have a sense of how managers and shareholders come to comprehend the complex environment in which they are situated. More generally, if observer A—a shareholder or manager—faces a complex environment, E, a regulator will face a larger and potentially more complex environment. This is because the complexity of that composite environment is a function of (1) two non-trivially complex components—observer A and environment E; (2) the manner in which those components interact; and (3) the way that the regulator interacts with the complexity posed by (1) and (2).

A second source of governance complexity is the number of legal and contractual rules that are used in a transactional or governance context; all other things being equal, governance

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137. Potential coordination failure plays an important role in business firms generally. See Chester I. Barnard, The Functions of the Executive 6 (1958) (arguing that “the survival of an organization depends upon the maintenance of an equilibrium of complex character in a continuously fluctuating environment . . . which calls for readjustment of processes internal to the organization”) (citation omitted); Simon, supra note 63, at 72 (stating that “cooperation will usually be ineffective—will not reach its goal, whatever the intentions of the participants—in the absence of coordination”); R. H. Coase, The Nature of the Firm, in 4 Economica 386 (1937), reprinted in The Firm, the Market, and the Law 33, 35–36 (1988) (arguing that within the firm, market mechanisms are replaced by an “entrepreneur-coordinator” who makes production decisions). See also Manuel A. Utset, Towards a Bargaining Theory of the Firm, 80 Cornell L. Rev. 540 (1995) (arguing that an important role of corporate governance is to reduce the costs associated with these coordination failures and bargaining breakdowns).

138. For a discussion of the complexity of legal rules, see Louis Kaplow, A Model of the Optimal Complexity of Legal Rules, 11 J. L. Econ. & Org. 150 (1995) (“Legal rules often are complex in order to distinguish different types of behavior that may have different consequences.”).
complexity will increase with the number of rules. The level of complexity will also depend on the way that rules interact with each other and the identity of the actor who is trying to make sense of a governance rule. Contractual rules and legal regulations do not always interact in a transparent manner, particularly if those interactions occur in the shadow of markets, which may or may not be fully efficient. Moreover, all other things being equal, a repeat player in a particular type of transaction will face a lower complexity constraint than would a consumer or inexperienced transacting party. It follows that designing legal rules to protect consumers is difficult, in part, due to this “complexity asymmetry” between the repeat players being regulated and the consumers being protected.

V. CONCLUSION

Financial meltdowns can create great welfare losses for society. The set of market meltdowns that occurred in 2007 and 2008 created the greatest retrenchment in the economy since the Great Depression. Financial meltdowns can occur due to the perfectly rational behavior of financial actors. This Article argued that rational actors will have an incentive to delegate financial intermediaries the risks associated with informational asymmetries. And that intermediaries themselves will often find it more economical to in turn transfer those risks to other intermediaries. This chain of “blind” transactions can become quite long, and can lead to information losses within financial system. As a result, they can increase the likelihood of financial meltdowns. In developing this general argument, the Article first discussed the nature of informational asymmetries and group pathologies common in financial transactions and the role of intermediaries and market in

139. In a perfectly efficient market, the equilibrium market price at a particular point in time will incorporate all relevant information; as a result, efficient markets help reduce complexity by allowing parties to ignore additional sources of information. See Hayek, supra note 1; Herbert Simon, Economics, Bounded Rationality and the Cognitive Revolution 27 (1992) (arguing that markets allow atomistic economic actors to conserve information, and thus “to behave rationally with relatively simple computations and on the basis of relatively little information”; and concluding that markets “make it possible for people of bounded rationality to make reasonable choices”). But when a market is not efficient, the level of complexity increases, as does the potential for complexity-driven market failures. See, e.g., Randall Dodd, Subprime: Tentacles of a Crisis, Fin. & Dev., Dec. 2007, at 15 (stating that mortgage-back security misvaluations in the period leading to Great Recession of 2007 were caused in part by the fact that the “price discovery process is not transparent, and there is no surveillance in the market to identify where there are vulnerable positions”).
dealing with both. It then argued that the decision to acquire information is an investment decision: An inter-temporal decision that requires an initial outlay that as a general matter will not be recoverable if the information is not pertinent or has become stale. As a result, there is often an option value associated with the decision to acquire information. That is, given the uncertainty surrounding the information and the general irreversibility of the investment, a party will decide to delay acquiring even valuable information to the extent that is even more valuable to delay until some of the uncertainty surrounding the value of the information has been resolved. All other things being equal, the greater the costs associated with acquiring and processing the information, the greater the value of delaying purchasing it. This is important in financial transactions given the inherent complexity of the parties and financial contracts involved. The Article also analyzes group pathologies that can increase the likelihood of financial meltdowns and the relationship between these and the incentive of financial actors to delay disclosing bad news.